FOSSIL ORGANISMS IN METEORITES.*

By Geo. W. Rachel.

Dr. Hahn's work, of which "SCIENCE" gave a short notice in its last issue, promises to revolutionize many views which have heretofore been believed to be firmly and irrevocably established. It is not at all necessary to accept all the conclusions and agree with all the various lines of reasoning, into which the author has been led by his results, but nobody will fail to perceive the portentous meaning of the results with which his untiring efforts in this important matter have been rewarded.

There has been formerly a manifest tendency to belittle small things and apparently insignificant phenomena, and bestow the greatest attention on those matters which impress the observer by their magnitude. Modern science has done away considerably with this erroneous method and has taught us that it is the little things which achieve great results in nature, as a rule. To this class of phenomena, which has been habitually underrated until a comparatively recent time, belong the meteorites, shooting stars and meteoric dust generally. Chladni's view that they fall from the skies, pronounced in 1795, was ridiculed by the learned men of the times. One member of a committee sent by the French Academy to investigate the fall of a meteorite in the neighborhood of L'Aigle, Le Luc, declared that he would really be forced to believe what the people who witnessed the fall said, if he did not know that such a thing was *utterly impossible*.

It was not long, however, until the celestial origin of these bodies was universally recognized, several other falls of large meteorites occurring during the first decade of the present century, which could no longer be explained away. After this various stones that were known to have fallen upon the earth were examined and described, and a good many more which were recognized to be of celestial origin. The number of all the various specimens thus investigated has gradually become very large. Kesselmayer, in his great work on the subject, describes 647 distinct falls.

It is not now necessary to recall the several results of these investigations, nor to describe the peculiar properties of meteorites on which the resemblances and differences between those celestial minerals and our terrestial rocks are based. Suffice it to state that between the two types which have been recognized, viz: those consisting exclusively of iron, and those which are composed of certain silicious minerals, such as Augite, Bronzite, Olivine, Anorthite and other Feldspars, there are all the possible combinations of both; the ferrous meteorites predominate, however, those with a considerable percentage of silicious constituents being comparatively rare, and the purely silicious still more so.

It is the latter, the silicious material, which has been examined with such remarkable results by Dr. Hahn. This occurs usually in light-colored spherical or pear-shaped masses (*χονδροὶ*) similar to the nests of crystals (druses) which are a well-known occurrence in crystalline rocks. These peculiar forms consist principally of Bronzite and Enstatite, which to the naked eye show an appearance graphically described by Kesselmayer twenty years ago.

Prof. Gümbel, of Munich, in a report made to the Royal Bavarian Academy of Sciences has described them, on the basis of Kesselmayer's book and his own researches, as follows:

"Longitudinal sections show columns and fibres, composed of small polyhedra, which in cross sections look like irregular polygons. These polygons often show a sort of radiating arrangement in their interior, issuing from what appears to be an ill-defined nucleus; this nucleus seems to have been changing its place gradually, for the radii show an irregularity such as would be produced by such change of site. The fibres, for that is what these structures look like, are not of equal size throughout, but taper off into points and occasionally even send off branches. This is especially visible in cross-sections where one set is apparently replaced by others, these in turn by others, and so on. All the fibres consist, as has been stated, of a light centre, and a dark enclosing substance."

This description was given in 1878, and it certainly reads like what Hahn has proved it to be: *fossil organisms!*

This successful amateur, for such he was before he succeeded in gaining his present reputation by his participation in the debate on the "*Eozöon canadense*," and then resigned his government position to pursue this peculiar line of research at his leisure—this "Gerichts-Referendarius, a D." has by an ingenious application of the comparatively new method of making transparent sections of these meteorites accomplished results of which many a specialist might be proud. In order to exclude the error to which human vision and draughtsmanship might be liable, he has prepared photographic reproductions of his specimens, and on 32 excellent plates he presents the scientific world with 142 of these highly interesting preparations. Most of the fossil structures thus revealed belong to the animal world, indeed, Hahn himself professes that he is unable to find evidences of vegetable organisms; these, however, since the appearance of his work in February, have been recognized by Prof. Karsten, of Schaffhausen, Switzerland, in sections prepared by him from a portion of the very meteorite in his possession which has furnished a considerable number of Hahn's specimens. Two of these Prof. Karsten has drawn, and the cuts are published in an exhaustive paper on Hahn's book, together with his own observations and those of others on this very subject in the German Journal "Die Natur," edited by Mr. Karl Mueller, of Halle, Prussia.

As to the genuineness of Dr. Hahn's discovery there can be no possible doubt, and it has been generally admitted—reluctantly by some, it is true—that these "Chondrites" consist almost exclusively of fossil organisms. Dr. D. F. Weinland, a member of the Academy of Sciences, of Philadelphia, where he formerly resided, has also published a review of Hahn's book in the "Ausland," edited by Friedrich Von Hellwald, of Tübingen, Wurtemberg, in which he states that by the kindness of the author he has had the opportunity of examining these specimens, and although this examination has not given exactly the same results in regard to the determination of the particular kind of organism, he cheerfully admits that they are organisms, and this fact will not be doubted by any one who scans the plates published by Dr. Hahn.

In a postscript to this review, Dr. Weinland informs the reader that the author has entrusted to him the difficult task of classifying all the fossil organisms in more than three hundred of his specimens—of which Hahn has prepared over six hundred—and Dr. Weinland who is a competent naturalist, gives a few of his preliminary results. He compares the material which these sections display to the detritus of which the youngest coral lime and sandstone (coralline crag) consist such as is found on the shores of the Mexican Gulf. He furthermore states that complete forms are rarely found, but that the material is sufficiently abundant to construct many complete species, in the manner usually applied to fossil remains.

The number of the various species of polypi, crinoids, spongiæ and algiæ which are united by a silicious material, Dr. Weinland estimates after a cursory examination at about fifty.

One of the corals is set down by various observers a

* Hahn, O. Die Meteorite (Chondrite) and ihre Organismen; Laupp; *Tübingen*, 1881, with 32 photolithographic plates.

resembling to the *Favosites Goldfussi* * from the Silurian *Grauwacke,'* another is compared to the *Calamopora Naumanni* from the same strata.

The structure of these corals is excellently preserved; the columnar structure, the stomata, the rays in the cells, indicating the partitions between the columns in cross-sections, in short, all the various parts can be perfectly well demonstrated.

Of Spongiæ Dr. Weinland has already determined three different genera. Of a peculiar bluish-colored sponge he says he could draw a perfect picture, so numerous are the various longitudinal and cross-sections in which it occurs, it would be as easy as it would be to draw it from a living sponge.

Algæ have also been recognized as forming part of this intricate network of fossils. Dr. Weinland has determined several as belonging to the *Cocconeïs*, while Prof. Karsten describes others belonging to the genera, *Leptothrix*, *Leptomitus* and *Hysterophyma*. (The latter gentleman reminds the reader of the fact, that Reinsch has lately demonstrated the existence of these and other Algæ in coal, some of his specimens containing as much as twenty per cent of such organisms.

But what is the most interesting feature of all the organisms thus ingeniously and unexpectedly brought to light in meteorites is their Lilliputian size. The coral-tree, above referred to as a *Favosites*, presents itself to the naked eye as a white spot on the section, not larger than a pin's head. Its greatest diameter measures nine-tenths of a millimeter, and the single cells not more than about five one-hundreths of a millimeter. All the other organisms detected show the same pygmean proportions, the spiculae of sponges. for instance, being absolutely indefinable to the naked eye.

The origin and formation of these celestial fossils could not possibly have been different from what we know it to be with our terrestrial specimens. They tell us of a planet, on which aquatic life was sufficiently developed to produce them and to preserve them after death by a process of infiltration with silicious material, which dissolved the lime of which these structures must have consisted as far as their inorganic constituents are concerned, and supplanted it by the various kinds of silicious minerals, filling up also the interstices and openings which had formerly contained organic substance. This planet, therefore, must have had a comparatively long period of existence; it must have had an atmosphere and its surface must in whole, or in part, have been covered by water. What the cause has been of its destruction and its utter disintegration we are, certainly, unable to tell; but the meteoric stones which formed part of it have happily crossed the orbit of our planet and thus enabled us to divine its history, at least in part.

In connection with this subject, it may not be amiss to give a short synopsis of the history of our knowledge of organic constituents in meteoric stones.

The first to detect the existence of organic substance in meteorites was the great Woehler. In the meteorite which fell on April 17th, 1857, near Kaba in Hungaria, he found unmistakable traces—while analyzing it—of a combination of Carbon and Hydrogen. Then the fact was remembered that on Oct. 13th, 1835, a fire ball had exploded in the neighborhood of Bokkeveld, Cape Colony, scattering a great number of soft, black stones over the fields, weighing, as far as could be judged, several hundred pounds. These stones emitted a strong ammoniacal smell and were found to be impregnated with water and bitumen. Woehler obtained one of these meteoric stones and found that it contained, besides one and two-thirds per cent of carbon, a quarter of one per cent of organic matter proper.

Referring to this discovery, Friedrich Mohr* wrote, sixteen years ago:

"This is sufficient proof that there was present in this meteorite a carbo-hydrate similar to our ozocerite, idrialite, seberrerite, mineral wax, etc. According to our terrestrial experience we must therefore conclude that on the planet of which they formed part, there must have existed organisms, at least plants, which are the real cause of the many deoxidized combinations which we find in meteorites. The existence of plants would evidently condition the presence of free oxygen, which does not speak against the presence of these products of deoxidation, since the plants themselves require oxygen for completing their cycle, in so far as they are ultimately (by decomposition), re-transformed into carbonic acid, without which condition a long, unbroken chain of vegetable life would be inconceivable. But the water must be liquid in order to act, and this implies that this planet must have had a certain size to enable it to be sufficiently warmed by the sun. The small meteorites, as they come to us, must in spite of their being exposed to the sun's rays, have the temperature of cosmic space, since they are, just as are high mountain peaks, too insignificant to become heated by insolation alone. Only an enlargement of size enables a celestial body to develop heat enough to produce a warm atmosphere. This circumstance supports strongly the view, that meteorites have not been formed independently, but that they have formed part of a larger body, on which processes, similar to those obtained on our planet, have been going on."

This is certainly interesting reading to-day, knowing as we do that the planet in question has also been an abode of animal life.

Other meteorites containing organic substances have been recorded since then. Thus at Orgueil, France, 1864; at Knyahinya, Hungary, June 9, 1866. This phenomenon is the most important since very many of the most convincing specimens, prepared by Dr. Hahn, have been obtained from a stone weighing 27 lbs., which formed part of the 600 lbs. that fell in that particular locality on that day.

The most curious meteoric shower, however, was observed in 1870 in Sweden. Black pieces, consisting almost exclusively of mold, descended on a snow-field, and could thus be easily collected. Mold is always the result of some organic process, and living particles play the efficient part in its production.

Since bacteria are known to be able to withstand a temperature of —100° C, without losing vitality, the Thompson–Richter hypothesis of the propagation of life through the universe in this manner becomes almost a tangible reality. But, we forbear! The perspective opened by Dr. Hahn's discovery is too grand to be discussed in the brief space, allowed this notice. It is only to be regretted that the favored discoverer seems inclined to tamper with his good fortune in so far as he draws conclusions from his newly established facts which few will be willing to admit. He thinks it possible that the formation of living matter may have begun in cosmic space, that cells were developed from Chaos and a certain vegetative process could have gone on in the gaseous and liquid masses supr posed to have been the formative matter of our sola-system, etc. Prof. Karsten is even of the opinion that meteorites might form in the upper strata of our atmosphere. As proof he adduces the few recorded showers of polygonal hail-stones and especially the two cases of ice-meteorites. On May 28th, 1802, there fell near Puztemischel, Hungary, a block of ice weighing 1200lbs. and Hayne in his "Tracts historical and statistical on India" reports the fact that near Seringapatam a mass of ice fell from heaven, as large as an elephant, which took, in spite of the tremendous heat, over two days to melt.

* A drawing of this fossil coral is given by DANA in his *Textbook on Geology*, on page 111. (Ed. 1868.)

**Geschichte der Erde*, 1866, p. 500.

If we should be asked our opinion as to what the origin of these ice-meteorites may have been, we should be inclined to answer that they are very probably a small part of the collections of water (oceans?) which, we know, must have existed on the disintegrated planet to which our stone and iron-meteorites once belonged.

The various theories which have been held to explain certain well-known facts about meteoric bodies, notably Schiaparelli's ingenious hypothesis connecting comets with meteorites, the fact that most comets give a spectrum, closely resembling that of carbon, and many others will have to be revised in the light of this discovery, and it may be safely claimed that Dr. Hahn's book will prove to be one of the most important contributions to natural science of the present time.

ASTRONOMY.

Prof. Mark W. Harrington, of Ann Arbor Observatory, announces, in a private letter to the editor, the variability of star D. M. + 0° .2910, the position of which for 1855.0 is

A. R. 12h. 6m. 28.4s. Decl. + 0° 23.5′

It reached its minimum on May 22 or 23, when it was of the magnitude of D. M. + 0° .2914, which is given by Argelander as 8.7. It is now increasing in brightness at the rate of a tenth of a magnitude a day. The star, in the same right ascension and in 15′ south of the variable (D. M. + 0° .2911), is of a fine orange color, and should be put in the list of red stars.

Observers desiring information, charts, or comparison stars, for use in observing the variable, will be cheerfully assisted by Prof. Harrington or the editor.

M. Eugene Block, of the Observatory of Odessa, Russia, has communicated the following observations and elements of Comet (*a*), 1881, Swift:

Odessa M. T.	App. α.	App. δ.
1881 *d. h. m. s.*	*h. m. s.*	° ′ ″
May 4 14 50 15	0 15 26.53	+ 33 25 3.7
5 14 28 12	0 19 1.00	+ 32 24 36.7
7 14 36 2	0 26 35.05	+ 30 15 5.9

ELEMENTS.

T = 1881, May 20.8294.

π = 299° 47′ 53″
Ω = 123 59 25
i = 79 33 0
log. q = 9.76570.

The comparison with the middle place gives

Obs. − *c*, $\delta\lambda \cos\beta = -27''$
$\delta\beta = +3''$

Careful search has been made at Boston, at Cambridge by Mr. Wendell, at Clinton, N. Y., by Prof. Peters, and by others, for Barnard's Comet, but without success.

SCIENCE OBSERVER,
Special Circular No. 13.

BOSTON, *June* 2, 1881.

UNDERGROUND WIRES IN PARIS.—The Municipal Council of this city are contemplating adding to their funds by taxing wires placed in the sewers. The proposed tax will be 20fr. per kilometre up to 500, 30fr. from 500 to 1,000, 40fr. from 1,000 to 1,500, and so on, with an increase of 10fr. for each 500 kilometres. *L'Electricité* says that the number of kilometres of wire placed in the sewers being about 7,000, the Compagnie des Téléphones will have to pay something like 59,500fr. It adds that the company make no objection to this tax.

BOOKS RECEIVED.

SECOND REPORT OF THE UNITED STATES ENTOMOLOGICAL COMMISSION, for the years 1878 and 1879, relating to the Rocky Mountain Locust, and the Western Cricket, etc., with illustrations, Washington 1880.

This volume will be read with interest by naturalists, and the facts and statistics relating to the ravages of locusts, and the laws and characteristics governing their migrations are very complete.

The interesting chapter entitled "The Brain of the Locust" opens with these lines. "In order to appreciate the habits, migratory, reproductive, etc., of the locust, and to learn something of its general intelligence as an insect, and as compared with other insects, it is necessary for us to study with a good deal of care the organ of the locust's *mind, i. e.*, its nervous system, comprising its nervous centres and the nerves arising from them. The present chapter will be devoted to a study of the brain."

It may be confidently affirmed that with methods far subtler and reasoning much more profound, than any employed by the author of this chapter, we shall always fail to find in the structure of the nervous system any explanation of the migratory and reproductive or of any other habits *as habits* in any animal. A large wing-ganglion means a flying insect—of course, a large optic ganglion means that vision is a powerful sense in the animal in which it is found; an atropic olfactory bulb, in man the monkeys and seals, means that the sense of smell does not play so important a role in these animals as in the fox, dog, lion, camel and opossum, where the bulb is large. The preponderance of the brachial enlargement of the cord in the mole and bat is related to the preponderance of the anterior extremities over the posterior in these animals, but it no more serves to explain the difference in psychical habits existing between the two, nay it does so to a less degree even than the external structure. There are species of locusts which are not migratory and a study of their brains should be made if Mr. Packard wishes to draw inferences as to habits from the cerebral structure; in other words, if he would trace out the line of demarcation between a "migratory" and a "non-migratory" brain.

We believe that the clause in question has been inserted with the purpose of indicating that there *is* a connection between the chapter it opens and the general purposes of the Report. If so, if it was the writer's object to lead the lay mind to look upon his paper as pointing out methods by which, through a careful pursuit of the logical lines and the ratiocination passing through the cells or nerve-tracts of the locust's nervous system, we should in course of time be enabled to overreach and anticipate him by our superior reasoning power, in a manner comparable to that followed by a detective shadowing a forger, we can only say that it might have been omitted. Science needs no apology and the excellent plates accompanying this part of the Report alone justify the expense incurred by Government in getting them up.

We consider it unfortunate that in a chapter not likely to be perused by the lay reader at all, so much matter of a semi-popular character should have been included. It is the attempt to popularize the distinction between the brain of insects and of vertebrates (p. 224) that has led Mr. Packard to the commission of actual errors. Thus speaking of the nervous system of vertebrates, he says: "The gray matter is situated in the centre and consists largely of nerve or so-called 'ganglion cells,' while the external white matter of the brain or cord is composed of a mass of nerve fibres." This is correct only as applying to the very lowest vertebrates; in man, the mammalia and reptilia, the gray matter is more or less near the surface, in some centers altogether *cortical*, while the white matter is internal. Mr. Packard adds, as another